

TABLE 4.—Summary of solar radiation intensity measurements made at the Blue Hill Meteorological Observatory, Milton, Mass., during October 1933—Continued

[I_m =total intensity; I_r =that transmitted by red filter; I_y =that by yellow filter]

| Date and hour angle from solar noon | Solar altitude, α | Air mass, m . | I_m | I_r | I_y | Sky conditions; clouds, haze (hz), smoke (smk), visibility (v), wind |
|-------------------------------------|--------------------------|-----------------|----------|----------|----------|--|
| <i>Oct. 21</i> | | | | | | |
| 2:28 a.m. | 27 10 | 2.18 | gr. cal. | gr. cal. | gr. cal. | 2 Ci, Cist, Cisc, few Frcu; v 6; NE-3. |
| <i>Oct. 22</i> | | | | | | |
| 2:32 a.m. | 25 07 | 2.35 | 1.202 | .968 | .774 | 0 clouds; v 9; WNW-5. |
| 1:21 a.m. | 31 50 | 1.89 | 1.382 | .992 | .796 | 0 clouds; v 8-9; NW-3. |
| 0:23 a.m. | 35 04 | 1.74 | 1.418 | 1.022 | .824 | Few Cist; v 8-9; N-3. |
| 2:53 p.m. | 22 25 | 1.61 | 1.215 | .986 | .723 | |
| <i>Oct. 23</i> | | | | | | |
| 2:28 a.m. | 24 44 | 2.38 | 1.350 | 1.035 | .817 | Few Steu; v 9-10; NNW-3. |
| 0:07 p.m. | 34 46 | 1.75 | 1.361 | .968 | .765 | Few Ci; v 9; NW-3. |
| <i>Oct. 24</i> | | | | | | |
| 2:33 a.m. | 24 02 | 2.45 | 1.048 | .792 | .650 | 1 Ci, 2 Cist; hz over sun; v 6-7; N-4. |
| 1:10 a.m. | 31 43 | 1.90 | 1.197 | .846 | .684 | |
| <i>Oct. 25</i> | | | | | | |
| 1:05 a.m. | 31 40 | 1.90 | .904 | .684 | .549 | Hz over sun; v 6; SW-2. |
| 2:58 p.m. | 20 24 | 2.85 | .626 | .503 | .405 | Few Ci; dense hz; v 6; WSW-2. |

POSITIONS AND AREAS OF SUN SPOTS

[Communicated by Capt. J. F. Hellweg, Superintendent United States Naval Observatory. Data furnished by Naval Observatory, in cooperation with Harvard, Perkins, and Mount Wilson observatories. The differences of longitude are measured from central meridian, positive west. The north latitudes are plus. Areas are corrected for foreshortening and are expressed in millionths of sun's visible hemisphere. The total area, including spots and groups, is given for each day in the last column]

| Date | Eastern stand-ard civil time | Heliographic | | | Area | | Total area for each day |
|-----------------------------|------------------------------|--------------|------------|------------|----------|-------|-------------------------|
| | | Diff. long. | Longi-tude | Lat-i-tude | Spot | Group | |
| 1933 | | | | | | | |
| Oct. 1 (Naval Observatory) | 12 2 | ° | ° | ° | No spots | | |
| Oct. 2 (Naval Observatory) | 13 7 | | | | No spots | | |
| Oct. 3 (Naval Observatory) | 11 48 | | | | No spots | | |
| Oct. 4 (Mount Wilson) | 9 48 | | | | No spots | | |
| Oct. 5 (Naval Observatory) | 14 24 | | | | No spots | | |
| Oct. 6 (Naval Observatory) | 11 9 | | | | No spots | | |
| Oct. 7 (Naval Observatory) | 11 0 | | | | No spots | | |
| Oct. 8 (Naval Observatory) | 13 50 | | | | No spots | | |
| Oct. 9 (Naval Observatory) | 11 12 | | | | No spots | | |
| Oct. 10 (Naval Observatory) | 11 10 | | | | No spots | | |
| Oct. 11 (Naval Observatory) | 11 49 | | | | No spots | | |
| Oct. 12 (Naval Observatory) | 12 16 | | | | No spots | | |

| Date | Eastern stand-ard civil time | Heliographic | | | Area | | Total area for each day |
|-----------------------------|------------------------------|--------------|------------|------------|----------|-------|-------------------------|
| | | Diff. long. | Longi-tude | Lat-i-tude | Spot | Group | |
| Oct. 13 (Mount Wilson) | 11 20 | ° | ° | ° | No spots | | |
| Oct. 14 (Naval Observatory) | 11 41 | | | | No spots | | |
| Oct. 15 (Naval Observatory) | 11 42 | | | | No spots | | |
| Oct. 16 (Naval Observatory) | 12 23 | | | | No spots | | |
| Oct. 17 (Naval Observatory) | 12 14 | | | | No spots | | |
| Oct. 18 (Naval Observatory) | 12 9 | | | | No spots | | |
| Oct. 19 (Naval Observatory) | 10 39 | | | | No spots | | |
| Oct. 20 (Naval Observatory) | 13 14 | | | | No spots | | |
| Oct. 21 (Naval Observatory) | 12 11 | | | | No spots | | |
| Oct. 22 (Naval Observatory) | 11 38 | | | | No spots | | |
| Oct. 23 (Mount Wilson) | 9 50 | | | | No spots | | |
| Oct. 24 (Mount Wilson) | 9 50 | | | | No spots | | |
| Oct. 25 (Naval Observatory) | 11 51 | | | | No spots | | |
| Oct. 26 (Naval Observatory) | 12 27 | -2.0 | 89.5 | +8.5 | | | 123 |
| Oct. 27 (Naval Observatory) | 12 12 | +12.0 | 90.4 | +9.0 | | | 93 |
| Oct. 28 (Naval Observatory) | 10 54 | +25.0 | 91.0 | +9.0 | | | 93 |
| Oct. 29 (Naval Observatory) | 10 57 | +38.0 | 90.7 | +9.0 | | | 93 |
| Oct. 30 (Naval Observatory) | 12 19 | +52.0 | 90.8 | +8.0 | | | 62 |
| Oct. 31 (Naval Observatory) | 12 5 | +66.0 | 91.7 | +7.5 | | | 46 |
| Mean daily area for October | | | | | | | 16 |

PROVISIONAL SUN-SPOT RELATIVE NUMBERS FOR OCTOBER 1933

(Dependent alone on observations at Zurich and its station at Arosa)

[Data furnished through the courtesy of Prof. W. Brunner, Eidgenössische Sternwarte, Zurich, Switzerland]

| October 1933 | Relative numbers | October 1933 | Relative numbers | October 1933 | Relative numbers |
|--------------|------------------|--------------|------------------|--------------|------------------|
| 1 | 0 | 11 | 0 | 21 | 0 |
| 2 | 0 | 12 | | 22 | 0 |
| 3 | 0 | 13 | | 23 | 0 |
| 4 | 0 | 14 | 0 | 24 | 0 |
| 5 | 0 | 15 | 0 | 25 | 0 |
| 6 | 0 | 16 | | 26 | Mc9 |
| 7 | 0 | 17 | | 27 | 20 |
| 8 | 0 | 18 | | 28 | 19 |
| 9 | | 19 | 0 | 29 | 14 |
| 10 | 8 | 20 | 0 | 30 | 14 |
| | | | | 31 | 12 |

Mean: 28 days=3.4.

Mc=New formation of a center of activity; M, in the central zone.

AEROLOGICAL OBSERVATIONS

[Aerological Division, W. R. Gregg, in charge]

By L. T. SAMUELS

There was considerable variation this month in the free-air temperature departures. They were greatest at Pembina (table 1) and negative at all levels, while at Omaha they were positive and of only slightly less magnitude. At the other stations the temperature departures were mostly of small-to-moderate magnitude with the signs varying considerably. Large positive departures occurred in the lower levels at Dallas and in the upper levels at Boston.

In practically all cases the relative humidity departures were of opposite sign to those for temperature except at

San Diego, where positive departures for both of these elements prevailed.

Resultant free-air winds for October were close to normal both in direction and velocity at most stations and levels (table 2). Exceptions to this occurred, however, at Pembina and Omaha, referred to above in connection with marked differences in temperature departures. At Pembina the resultant velocities were below normal while at Omaha they exceeded the normal. The resultant directions were normal at both stations.

TABLE 1.—Free-air temperatures and relative humidities obtained by airplanes during October 1933

TEMPERATURE (°C.)

| Altitude (meters) m.s.l. | Boston, Mass. ¹ (6 meters) | | Cleveland, Ohio ² (246 meters) | | Dallas, Tex. ³ (146 meters) | | Norfolk, Va. ⁴ (3 meters) | | Omaha, Nebr. ⁵ (300 meters) | | Pembina, N.Dak. ⁶ (243 meters) | | Pensacola, Fla. ⁴ (2 meters) | | San Diego, Calif. ⁴ (9 meters) | | Washington, D.C. ⁴ (2 meters) | |
|-----------------------------|--|-----------------------------|---|-----------------------------|---|-----------------------------|---|-----------------------------|---|-----------------------------|---|-----------------------------|---|-----------------------------|---|-----------------------------|--|-----------------------------|
| | Mean | Departure from normal | Mean | Departure from normal | Mean | Departure from normal | Mean | Departure from normal | Mean | Departure from normal | Mean | Departure from normal | Mean | Departure from normal | Mean | Departure from normal | Mean | Departure from normal |
| | | | | | | | | | | | | | | | | | | |
| Surface | 10.8 | (?) | 8.3 | (?) | 15.6 | (?) | 14.3 | -0.4 | 6.4 | (?) | 0.2 | (?) | 18.6 | +0.4 | 17.2 | -2.0 | 10.3 | -2.5 |
| 500 | 8.4 | (?) | 10.0 | (?) | 18.8 | (?) | 13.9 | +3 | 8.6 | (?) | 1.8 | (?) | 18.3 | +6 | 17.5 | -5 | 10.7 | -1.3 |
| 1,000 | 7.1 | +1.4 | 8.0 | -0.6 | 18.1 | +3.0 | 11.7 | +5 | 10.8 | +1.6 | 1.4 | -3.4 | 16.4 | +6 | 20.1 | +2.1 | 9.9 | -2 |
| 1,500 | 5.4 | +1.6 | 5.6 | -7 | 16.2 | +3.1 | — | — | 9.7 | +2.0 | -5 | -3.6 | — | — | — | — | — | — |
| 2,000 | 3.9 | +1.7 | 3.3 | -6 | 13.8 | +2.9 | 8.2 | +8 | 7.7 | +2.2 | -2.7 | -3.8 | 10.9 | -1.0 | 16.7 | +2.5 | 6.7 | +6 |
| 2,500 | 2.5 | +2.5 | 1.6 | 0 | 10.7 | +2.2 | — | — | 5.7 | +2.8 | -5.4 | -4.1 | — | — | — | — | — | — |
| 3,000 | .7 | +3.7 | -8 | +2 | 7.4 | +1.3 | 4.3 | +1.1 | 2.8 | +2.6 | -7.9 | -3.9 | 5.7 | -1.7 | 9.8 | +1.2 | 3.4 | +1.1 |
| 4,000 | -4.2 | +4.5 | -5.8 | +1 | 1.3 | +4 | — | — | -2.9 | +2.1 | -12.9 | -3.3 | .0 | -1.9 | 2.5 | +0.7 | — | — |
| 5,000 | -9.5 | — | -11.7 | -5 | -4.9 | -1.0 | — | — | -9.1 | +1.8 | -19.0 | -4.2 | -6.5 | -2.0 | -4.8 | +0.3 | — | — |

RELATIVE HUMIDITY (PERCENT)

| | | | | | | | | | | | | | | | | | | |
|---------|----|-----|----|-----|----|-----|----|----|----|-----|----|-----|----|----|----|-----|----|----|
| Surface | 73 | (?) | 78 | (?) | 82 | (?) | 76 | +1 | 81 | (?) | 80 | (?) | 79 | 0 | 80 | +13 | 80 | +6 |
| 500 | 72 | (?) | 69 | (?) | 67 | (?) | 67 | +1 | 68 | (?) | 70 | (?) | 74 | +2 | 74 | +11 | 68 | +4 |
| 1,000 | 67 | -7 | 68 | +6 | 61 | -3 | 64 | +2 | 49 | -7 | 62 | +3 | 69 | +1 | 50 | +3 | 60 | -1 |
| 1,500 | 64 | -5 | 62 | +5 | 58 | 0 | — | — | 45 | -8 | 57 | +5 | 60 | +3 | 35 | +2 | 50 | -6 |
| 2,000 | 60 | -3 | 58 | +5 | 55 | +3 | 50 | -1 | 43 | -10 | 58 | +5 | 52 | +4 | 30 | +3 | 44 | 0 |
| 2,500 | 55 | -5 | 45 | -3 | 54 | +7 | 34 | -5 | 44 | -6 | 55 | +6 | 43 | +1 | 29 | +4 | — | — |
| 3,000 | 50 | -15 | 47 | +1 | 54 | +12 | — | — | 42 | -4 | 53 | +6 | 43 | +1 | 25 | +2 | — | — |
| 4,000 | 47 | — | 50 | +7 | 44 | +4 | — | — | 43 | 0 | 53 | +8 | 41 | +1 | — | — | — | — |
| 5,000 | 47 | — | 44 | +12 | 37 | 0 | — | — | — | — | — | — | — | — | — | — | — | — |

Times of observations: Weather Bureau, 5 a.m.; Navy, 7 a.m. and M.I.T., 8 a.m. (E.S.T.).

¹ Airplane observations made by Massachusetts Institute of Technology; departures based on normals obtained from kite observations made at Blue Hill Meteorological Observatory.² Temperature departures based on normals determined by extrapolating latitudinally those of Royal Center, Ind., and Due West, S.C. Humidity departures based on normals of Royal Center, Ind.³ Temperature departures based on normals determined by interpolating latitudinally those of Groesbeck, Tex., and Broken Arrow, Okla. Humidity departures based on normals of Groesbeck, Tex.⁴ Naval air stations.⁵ Temperature and humidity departures based on normals of Drexel, Nebr.⁶ Temperature departures based on normals determined by extrapolating latitudinally those of Ellendale, N.Dak., and Drexel, Nebr. Humidity departures based on normals of Ellendale, N.Dak.⁷ Surface and 500-meter level departures omitted because of difference in time of day between airplane observations and those of kites upon which the normals are based.

TABLE 2.—Free-air resultant winds (meters per second) based on pilot balloon observations made near 7 a.m. (E.S.T.) during October 1933

[Wind from N=360°, E=90°, etc.]

| Altitude (meters) m.s.l. | Albuquerque, N. Mex. (1,554 meters) | | Atlanta, Ga. (309 meters) | | Bismarck N. Dak. (518 meters) | | Brownsville, Tex. (7 meters) | | Burlington, Vt. (132 meters) | | Cheyenne, Wyo. (1,873 meters) | | Chicago, Ill. (192 meters) | | Cleveland, Ohio (245 meters) | | Dallas, Tex. (154 meters) | | Havre, Mont. (762 meters) | | Jackson- ville, Fla. (14 meters) | | Key West, Fla. (11 meters) | | | |
|-----------------------------|---|----------|---------------------------------|----------|-------------------------------------|----------|------------------------------------|----------|------------------------------------|----------|--|----------|----------------------------------|----------|------------------------------------|----------|---------------------------------|----------|---------------------------------|----------|--|----------|----------------------------------|----------|-----------|----------|
| | Direction | Velocity | Direction | Velocity | Direction | Velocity | Direction | Velocity | Direction | Velocity | Direction | Velocity | Direction | Velocity | Direction | Velocity | Direction | Velocity | Direction | Velocity | Direction | Velocity | Direction | Velocity | Direction | Velocity |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Surface | ° | 1.1 | ° | 1.8 | 310 | 0.6 | 358 | 0.3 | 200 | 2.2 | 279 | 3.1 | 225 | 2.0 | 210 | 1.4 | 135 | 1.3 | 261 | 1.4 | 360 | 2.2 | 41 | 2.9 | | |
| 500 | 7 | 3.8 | 64 | 3.2 | 143 | 3.2 | 216 | 5.2 | 216 | 5.4 | — | — | 250 | 6.1 | 244 | 4.2 | 154 | 5.4 | 54 | 6.2 | 60 | 6.1 | — | — | | |
| 1,000 | 79 | 2.5 | 282 | 3.3 | 139 | 2.6 | 243 | 5.4 | — | — | 261 | 6.3 | 259 | 5.7 | 195 | 4.0 | 253 | 3.8 | 77 | 4.6 | 76 | 5.0 | — | — | | |
| 1,500 | 294 | 1.8 | 297 | 5.9 | 100 | 1.4 | 278 | 5.1 | — | — | 274 | 7.9 | 252 | 7.6 | 251 | 2.9 | 282 | 6.2 | 90 | 2.1 | 87 | 3.3 | — | — | | |
| 2,000 | 9 | .9 | 300 | 3.4 | 295 | 6.9 | 81 | 1.6 | 275 | 6.2 | 276 | 4.6 | 283 | 8.6 | 260 | 8.3 | 282 | 3.0 | 282 | 6.3 | 278 | 1.8 | 90 | 1.5 | — | — |
| 2,500 | 309 | 2.7 | 276 | 3.6 | 297 | 8.0 | 48 | 1.7 | 279 | 10.1 | 278 | 7.5 | 290 | 9.8 | 270 | 8.4 | 308 | 3.5 | 281 | 7.8 | 285 | 4.0 | 180 | .6 | — | — |
| 3,000 | 293 | 4.1 | 281 | 5.8 | 293 | 8.3 | 6 | 2.5 | 276 | 11.0 | 255 | 9.9 | 288 | 9.5 | 267 | 9.8 | 314 | 3.7 | 285 | 8.9 | 277 | 3.9 | 208 | .2 | — | — |
| 4,000 | 284 | 4.5 | 257 | 5.1 | — | — | 315 | 3.0 | 258 | 13.0 | 290 | 11.1 | — | — | — | — | 347 | 3.0 | 301 | 11.8 | 312 | 3.7 | 276 | 2.1 | — | — |
| 5,000 | 280 | 4.6 | — | — | — | — | — | — | 301 | 6.5 | — | — | — | — | — | — | 264 | 3.6 | — | — | 292 | 2.4 | 290 | 4.3 | — | — |

| Altitude (meters) m.s.l. | Los An- geles, Calif. (217 meters) | | Medford, Oreg. (410 meters) | | Memphis, Tenn. (83 meters) | | New Or- leans, La. (2 meters) | | Oakland, Calif. (8 meters) | | Oklahoma City, Okla. (402 meters) | | Omaha, Nebr. (306 meters) | | Phoenix, Ariz. (338 meters) | | Salt Lake City, Utah (1,294 meters) | | Sault Ste. Marie, Mich. (198 meters) | | Seattle, Wash. (14 meters) | | Washing- ton, D.C. (10 meters) | | | | | |
|-----------------------------|--|----------|-----------------------------------|----------|----------------------------------|----------|-------------------------------------|----------|----------------------------------|----------|---|----------|---------------------------------|----------|-----------------------------------|----------|--|----------|---|----------|----------------------------------|----------|--------------------------------------|----------|-----------|----------|---|---|
| | Direction | Velocity | Direction | Velocity | Direction | Velocity | Direction | Velocity | Direction | Velocity | Direction | Velocity | Direction | Velocity | Direction | Velocity | Direction | Velocity | Direction | Velocity | Direction | Velocity | Direction | Velocity | Direction | Velocity | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Surface | ° | 1.0 | 171 | 0.6 | 25 | 0.5 | 39 | 2.3 | 210 | 0.4 | 151 | 1.5 | 173 | 0.5 | 91 | 2.8 | 155 | 4.0 | ° | ° | 228 | 0.1 | 138 | 1.6 | 329 | 1.3 | | |
| 500 | 32 | 1.0 | 212 | .2 | 127 | 1.1 | 74 | 5.3 | 339 | 2.0 | 148 | 2.4 | 213 | 1.7 | 100 | 3.4 | — | — | 243 | 2.8 | 190 | 2.5 | 349 | 3.5 | — | — | | |
| 1,000 | 42 | 1.2 | 228 | .5 | 285 | 1.6 | 84 | 3.4 | 360 | 3.3 | 208 | 5.0 | 277 | 4.4 | 109 | 1.7 | — | — | 272 | 6.1 | 184 | 2.8 | 310 | 4.2 | — | — | | |
| 1,500 | 68 | .7 | 188 | 1.3 | 282 | 3.5 | 68 | 2.0 | 349 | 2.1 | 245 | 4.7 | 291 | 5.9 | 139 | .9 | 163 | 3.4 | — | — | 269 | 7.2 | 217 | 2.6 | 290 | 5.4 | — | — |
| 2,000 | 87 | 2.1 | 208 | 2.3 | 287 | 4.4 | 19 | 2.1 | 344 | 1.4 | 263 | 5.0 | 278 | 7.6 | 141 | .9 | 206 | 1.4 | — | — | 275 | 10.0 | 243 | 4.3 | 289 | 6.8 | — | — |
| 2,500 | 90 | 3.4 | 257 | 3.1 | 292 | 5.9 | 338 | 2.4 | 357 | 1.4 | 264 | 4.7 | 286 | 9.5 | 160 | 1.3 | 283 | 2.0 | — | — | 252 | 5.3 | 252 | 3.7 | 282 | 8.4 | — | — |
| 3,000 | 63 | 3.3 | | | | | | | | | | | | | | | | | | | | | | | | | | |